



ARTS AND SCIENCE **GEOLOGY**



1982-83



CONCORDIA UNIVERSITY

DEPARTMENT OF GEOLOGY

COURSE GUIDE

1982-83

This course guide has been prepared months in advance of the 1982-83 academic year and information contained is subject to change.

Students are advised not to purchase any texts before consulting the department or professor concerned.

For more detailed information contact:

The Department of Geology

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7141 Sherbrooke St. West
Montreal, Quebec
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1455 de Maisonneuve Blvd. W.
Montreal, Quebec
Tel: (514) 879-4491

WHAT IS GEOLOGY

Geology is the scientific study of the planet Earth. The principles of geology, learned here on Earth, have also been vital parts of the scientific effort to understand the Solar System.

Study of rocks, minerals and fossils..., processes that shape the planetary surfaces and operate in their interiors..., the magnetic and other radiation fields of planets..., landslides, earthquakes and their prediction..., soil formation, erosion and conservation..., effect of man's activities on the Earth's environment..., metal, fuel and water resources, their search, use and conservation..., sites for roads, dams and buildings..., ocean floors and mountain heights..., surface features of the Moon..., all this and more is geology.

Scope of geology is too broad for any one scientist. Therefore, most geologists specialize in one or more facets of geology, much as engineers specialize in various fields of physical science such as electronics and construction. To mention a few specialities: those who study minerals and rocks need specialized training in chemistry and physics, as does the geochemist who is concerned with chemical processes in the Earth; those who study fossils must be trained in biology of plants and animals so that they can interpret the age and environment of fossils; those who study deformed rocks must know mechanics, and groundwater and petroleum geologists must be familiar with fluid dynamics. These specializations in geology, are usually emphasized at the graduate level. At the undergraduate level, however, students could, with the help of student advisers, select their electives with a particular specialization in mind.

GEOLOGY TODAY

Geology has started off the 1980s with a bang, both literally and figuratively. Explosive eruption from Mt. St. Helens and from other volcanoes; severe earthquakes; droughts, floods and disastrous slope failures; exciting discoveries from direct observations of the deep-sea floor and from images of the outer planets of the solar system are big news. Moreover, the end of the era of abundant and cheap energy from fossil fuels and the widespread realization that man's meddling with Nature was beginning to produce some long-term and perhaps irreversible deterioration of the environment has forced on every citizen the importance of knowing how the Earth works. Furthermore, the search for ever more elusive mineral and hydrocarbon deposits, the estimation of potential resources, the devising of sane conservation practices, all require progressively more sophisticated practice of geology. So, too, does a continuing assessment of the ability of the Earth's environment to sustain our edifices and to contain our wastes. The knowledge of geologists is needed more urgently and in more ways than ever before.

WHAT GEOLOGISTS DO

In pursuing a subject matter that is so varied and so large in scope, geologists engage in many kinds of activities. Field work may be a major part of their study. The results of field work have to be compiled in the office and reports written about results. This kind of work is centered around libraries. Much geological work is also done in the laboratory using various sophisticated equipment. Some geologists study natural processes, both in the field and in the laboratory. The main work of one group of geologists consists entirely of theorizing. The following are samples of some of the things geologists do:

- mapping on a regional scale the still unmapped parts of the Canadian Arctic Islands
- study in a laboratory properties of rocks and minerals at high pressure and high temperature
- SCUBA diving to study coral reefs off Barbados
- surveying on mule-back or helicopter the mineral potential of a mountainous area in Australia or South America
- exploring for water in an arid region

- work as a member of a UN mission to field study an earthquake stricken area in Turkey
- interpreting by means of satellite images the geology of vast inaccessible regions
- deciding if and where subsurface mining should be extended
- studying the ocean floor off Galapagos Islands with a group of scientists
- investigating the effects of acid rain in southern Ontario
- investigating the origin of the Earth's magnetic field
- teaching in school or teaching and research at university....
- advising a government on its mineral and energy policies



Exploring the Precordillera (Argentina) on horseback

EMPLOYMENT OPPORTUNITIES

Employment opportunities for new graduates in geology have been excellent during the last several years. Forecasters on future outlook are optimistic that opportunities for employment will be sustained at a high level for some years to come. The principal employers are: federal and provincial geological surveys, government research institutes, companies engaged in oil and mineral exploration and engineering works, the United Nations and U.N.-sponsored agencies, universities and schools. Some geologists practice their profession as consultants.

OBJECTIVES OF THE GEOLOGY DEPARTMENT

The main objective of the Geology Department is to offer the best undergraduate education in geology; best in the quality of the programmes, in the quality of teaching and facilities and in the quality of interaction between students and faculty members.

FULL TIME FACULTY AND THEIR FIELDS OF INTEREST

- P.S. Kumarapeli, Ph.D. (McGill), Associate Professor and Chairman
Tectonics, Geophysics
- H.S. de Romer, Ph.D. (McGill), Associate Professor
Structural Geology, Photogeology
- J.T. Jenkins, M.Sc. (McGill), Associate Professor
Crystal Chemistry, Mineralogy, Igneous and Metamorphic Petrology
- D.J. McDougall, Ph.D. (McGill), Professor
Mineral Physics, Thermoluminescence
- K.K. Mukherji, Ph.D. (Univ. of Western Ontario), Associate Professor
Carbonate Petrology, Sedimentation
- G.P. Sassano, Ph.D. (Univ. of Alberta), Associate Professor
Economic Geology

PART-TIME FACULTY (in 1981-82)

- S.T. Ahmedali, M.Sc. (McGill)
- Y. Bishay, Ph.D. (Univ. of Alexandria, Egypt)

STAFF

- L. Bertrand - Secretary
- C. Tilson - Technician

FACULTY RESEARCH

The faculty members have carried out geological work in various parts of Canada, the Alps, the Near East, Sri Lanka and in South America. Current research activities are concentrated in the Quebec Appalachians.

FACILITIES

In addition to general facilities and services such as the libraries and the computer centre provided by the university, the Department maintains well-equipped laboratories with adequate study collections of minerals and rocks including thin and polished sections for microscopic studies, fossils, maps and air photos. The Department also has its own x-ray diffraction equipment and geophysical equipment. Access to other analytical facilities such as Atomic Absorption and x-ray fluorescence equipment is available from other departments. Two 15-seater vehicles are available for field trips.

STUDENT PARTICIPATION

The Concordia Geology Club, run exclusively by students has reason to be proud of their record. Their activities include inviting guest lecturers, organizing field trips, preparing and manning exhibits at the annual Science week at Concordia University and at the Prospectors and Developer's Convention in Toronto, inviting through its job committee prospective employers to the campus to interview students for summer as well as permanent employment and organizing the several social events including the Spring sugaring-off party. Upper year students with above average academic records are provided the opportunity of getting teaching experience through demonstrating in laboratory classes. A stipend is paid for this work.

SCHOLARSHIPS, FINANCIAL AID, AWARDS, MEDALS AND PRIZES

Scholarships and prizes are given in recognition of outstanding academic achievements. The Andre Deland Medal for Geology is awarded annually, when merited, to the graduating student with the highest standing in geology. Two annual awards are given by the Canadian Society of Petroleum Geologists to undergraduates who have demonstrated outstanding competence in fields related to petroleum geology. Mineralogical Association of Canada also gives an annual award. Financial aid is given to help students solve individual problems. Students are advised to refer to the Office of the Dean of Students.

SUMMER EMPLOYMENT

Opportunities for summer employment have been excellent during the last several years. Students are urged to take the opportunity to gain valuable field experience and at the same time benefit from the high salaries attached to these jobs. Student Job Committee as well as the Department work towards getting prospective employers on campus but the task of job procurement is in the hands of the students. Federal and Provincial surveys and companies involved in mineral and oil exploration are the principal employers. This year, the summer employment situation in geology is somewhat depressed as is the case in most other areas. It is hoped that this situation is temporary.

PRE-UNIVERSITY EDUCATION FOR GEOLOGISTS

A sound foundation in fundamental sciences is a prerequisite to enter geology programmes intended for professional formation. The university requires that students follow the pre-Science profile 10.9 at the CEGEP level.



Mud cracks in Potsdam sandstone

GEOLOGY PROGRAMMES

As shown in the following tables the Department offers five programmes reflecting different levels of concentration in geology: Honours, Specialization, Major (option Ecology), Major and Minor. Out of the 90 credits necessary for the BSc., and normally taken over a 3-year period, the Honours programme specifies 75 credits; 63 credits for the Specialization; 45 credits for the Major, option Ecology; 39 credits for the major in geology and 24 credits are required for the Minor in Geology.

Students with professional aspirations are encouraged to register in the Honours or the Specialization programme. These two programmes are designed for professional formation and provide a balanced sequence of courses in theoretical and practical aspects of geology.

The major programmes are aimed at the generalist. They also satisfy the needs of students who wish to combine geology in a double major. Major-minor programmes which combine geology with physics, chemistry, biology, computer science, mathematics and geography can be arranged for individuals with interests in these fields. A scientific background is a desirable prerequisite for the minor programme in geology but not an essential one.

Lectures and laboratory work cannot successfully substitute for actual observation and study of geology in the field. Therefore, our department is convinced that field trips to areas of geological interest are an essential part of many courses. In addition, two field schools (Exploration Geology and Field Geology) are conducted by the staff in the two weeks immediately following the spring exams.



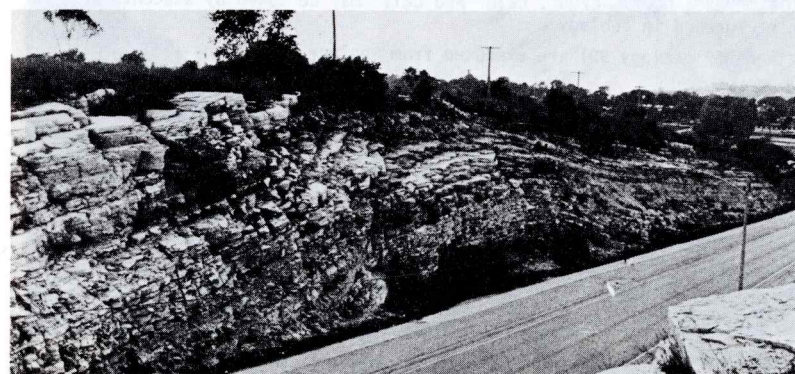
Geological field trip in the Bavarian Alps

BSc. Honours in Geology (75 crs.)

<u>I Year</u>	<u>II Year</u>	<u>III Year</u>
C211 ³ -Mineralogy I C212 ³ -Invertebrate Paleontology C213 ³ -Structural Geology C215 ³ -Photogeology C216 ³ -Exploration Geology C221 ³ -Physics of the Earth	C311 ⁶ -Introd. Petrology C312 ³ -Mineralogy II C313 ³ -Opt. Crystallography C314 ³ -Stratigraphy C315 ³ -Tectonics C316 ³ -Field Geology	C411 ⁶ -Igneous and Metamorphic Petrology C412 ⁶ -Economic Geology and Ore Deposits C413 ³ -Sedimentary Petrology C414 ³ -Research Project
in addition: 6 Science elective chosen from: Chem. C211 ⁶ , C231 ² , C232 ² Comp. C211 ³ , Math. C241 ⁶ Biol. C222 ³ , C223 ³	in addition: 3 elective credits in geology	in addition: 6 elective credits in geology

BSc. Specialization in Geology (63 crs.)

<u>I Year</u>	<u>II Year</u>	<u>III Year</u>
C211 ³ -Mineralogy I C212 ³ -Invertebrate Paleontology C213 ³ -Structural Geology C215 ³ -Photogeology C216 ³ -Exploration Geology C221 ³ -Physics of the Earth	C311 ⁶ -Introd. Petrology C312 ³ -Mineralogy II C313 ³ -Opt. Crystallography C314 ³ -Stratigraphy C315 ³ -Tectonics C316 ³ -Field Geology	C411 ⁶ -Igneous and Metamorphic Petrology C412 ⁶ -Economic Geology and Ore Deposits C413 ³ -Sedimentary Petrology
in addition: 6 science elective credits chosen from: Chem. C211 ⁶ , C231 ² , C232 ² Comp. C211 ³ , Math. C241 ⁶ Biol. C222 ³ , C223 ³		in addition: 3 elective credits in geology



Limestone road-cut in the St. Lawrence Lowlands

BSc. Major in Geology (Ecology Option) (45 crs.)

<u>I Year</u>	<u>II Year</u>	<u>III Year</u>
C210 ³ -Physical Geology C211 ³ -Mineralogy I C215 ³ -Photogeology C220 ³ -Earth History	C212 ³ -Invertebrate Paleontology C213 ³ -Structural Geology C311 ⁶ -Introductory Geology	C316 ³ -Field Geology
in addition: Biol. C230 ³ , C240 ³	in addition: Biol. C250 ³	in addition: 6 credits in geology; 3 credits in Ecology

BSc. Major in Geology (39 crs.)

<u>I Year</u>	<u>II Year</u>	<u>III Year</u>
C210 ³ -Physical Geology C211 ³ -Mineralogy I C212 ³ -Invertebrate Paleontology C213 ³ -Structural Geology	C220 ³ -Earth History C311 ⁶ -Introductory Petrology	12 geology elective credits approved by the Department
	in addition: 6 elective credits in geology	

BSc. Minor in Geology (24 crs.)

C210³ Physical Geology
C220³ Earth History
18 geol. elective credits of which no more than 9 credits can be chosen from the Geol. 200-209 series.

NOTE:

1. The superscript denotes the credit value
2. Geology C201³, C202³, C203³, C205³, C210³ and C211³ may be taken by students with no previous background in geology.
3. Students with CEGEP geology 901 are exempted from Geology C210.



Agglomerate outcrop

GEOLOGY C201

PRINCIPLES OF GEOLOGY (3 credits)

Professor: D.J. McDougall

Sec. 51 Wed 19:00-21:05 (Loy)

Description: The nature, origin and evolution of the universe, stars and of planetary systems: the physical properties of the Earth and its environment; the materials and structures of the Earth's interior and surface, and the processes affecting these regions, such as continental drift, the formation of oceanic basins and mountain building. Lectures only.

Texts: The Earth's Dynamic Systems - 3rd ed., W.K. Hamblin

Assignments & Grading: Mid term test 40%
Final examination 60%

Prerequisite: No previous background in geology required.



Natural bridge carved by an underground stream

Description: Geomorphology of the ocean floor with emphasis on the significance of themidoceanic ridges and trench systems. The physical and chemical characteristics and circulation of ocean waters and their causes. Tides and waves. Distribution and origin of terrigenous, biogenous, chemogenic, volcanogenic and polygenic sediments in the major ocean basins. Conditions of oceanic sedimentation. Quantitative distribution of suspended sedimentary materials at the ocean bottom. Size composition of suspensions and bottom sediments. Economic resource potential of the oceans. Lectures only.

Note: Geology students in Honours, Specialization or Major programmes may not take this course for Geology credits.

Texts: Introductory Oceanography, Thurman, Charles E. Merrill

Assignments & Grading: 1st mid term test 40%
Final exam 60%

Prerequisite: No previous background in geology required.



Backreef lagoon, patch reef, fore reef (San Andres, Bahama Bank)

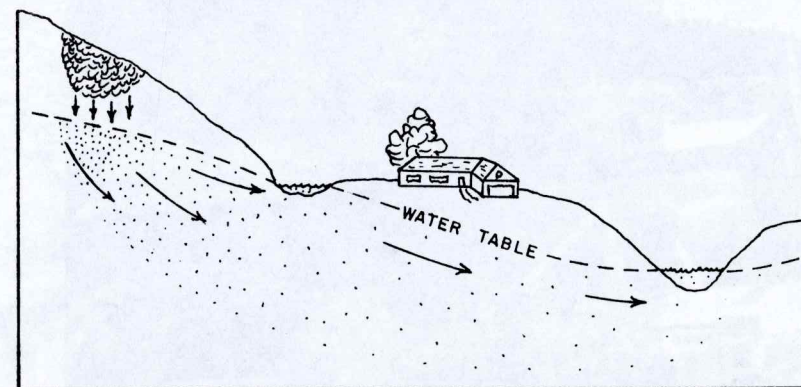
Description: Geology in the ecosystem. The earth's atmosphere, hydrosphere, lithosphere and biosphere in the geologic time. Long range geological effects of ecosphere pollution. Trace nutrients and health with emphasis on the geology of trace elements and its cause and effect on biological systems. Understanding of, control for, and prevention of natural hazards. Changes in the earth's climate. Role of Geology in land use. Lectures only.

Note: Geology students in Honours, Specialization or Major programmes may not take this course for Geology credits.

Texts: Man and his Geologic Environment, R.F. Mallory and D.N. Cargo, Addison Wesley

Assignments & Grading: Term tests 30%
Final examination 70%

Prerequisite: No previous background in geology required



Transport of contaminants to surface and groundwater from a dump site

GEOLOGY OF RESOURCES (3 credits)

Professor: G.P. Sassano

Sec. AA Wed 20:25-22:30 (SGW)

Description: Natural resources, social needs, consumption patterns, future needs. Geological processes, rock formation, mineral concentrations, formation of ore deposits. Economics of resources, processes of converting resource to reserve. Principles governing world distribution patterns of various natural resource commodities, metals and petroleum. Depletion patterns, political consequences. Hard decisions, resource policy, environmental issues. Lectures, seminars and term reports.

Texts: Earth Resources, Skinner, Prentice Hall
Our Finite Mineral Resources, Kestler, McGraw-Hill
Geology, Resources and Society, Menard, Freeman & Co.

Assignments & Grading: Term Tests 15%
Seminars and term reports 30%
Final written exam 55%

Prerequisite: No previous background in geology required.



A bush plane can only take so much cargo!

PHYSICAL GEOLOGY (3 credits)

Professor: D.J. McDougall

Sec. 01	TTh	13:15-14:30 (Loy)
Lab. 01	Thu	14:45-17:30 (Loy)

Sec. XX	Thu	18:05-20:10 (SGW)
Lab. AA	Thu	20:25-22:30 (SGW)

Description: An elementary study of minerals and rocks, and of the internal and external processes which shape the earth's surface. Laboratory work deals with identification of minerals, rocks and fossils, as well as interpretation of topographic and geologic maps. Field trips to Mt. Royal, Eastern Townships and Laurentians. Lectures and laboratory.

Texts: The Earth's Dynamic System, 3rd ed., W.K. Hamblin

Lab. Manual: Exercises in Physical Geology, Hamblin and Howard

Assignments & Grading: Laboratory tests 20%
Mid term 32%
Final exam 48%

Prerequisite: No previous background in geology required



Look what I found!

GEOLOGY C211

MINERALOGY I (3 credits)

Professor: J.T. Jenkins

Sec. 01	TTh	10:15-11:30 (Loy)
Lab. 01	Tue	14:45-17:30 (Loy)
Sec. XX	Mon	18:05-20:10 (SGW)
Lab. AA	Mon	20:25-22:30 (SGW)

Description: Physical and chemical properties of minerals. Crystallography, crystal notation, stereographic projection. Crystal structures. Identification, description and classification of minerals. One or two field trips near Montreal. Lectures and laboratory.

Texts: Hurlbut. Dana's Manual of Mineralogy, 19th ed. John Wiley & Sons, 1977.

Recommended References:

- Deer, Howie and Zussman. Introduction to Rock Forming Minerals. Longmans (paper-back), 1966.
- Bloss, F.D. Crystallography and Crystal Chemistry. Holt, Rinehart & Winston, 1971.
- Fleischer, M. Glossary of Mineral Species. Mineralogical Record Inc., 1980.

<u>Assignments & Grading:</u>	Lab. report	25%
	Periodic lab tests & final lab test	25%
	Final examination	50%

Prerequisite: No previous background in geology required



A cluster of quartz crystals from Quebec

GEOLOGY C212

INVERTEBRATE PALEONTOLOGY (3 credits)

Professor: K.K. Mukherji

Sec. 01	WF	11:45-13:00 (Loy)
Lab. 01	Mon	14:45-17:30 (Loy)

T.B.A.

Sec. XX	Tue	18:05-20:10 (SGW)
Lab. AA	Tue	20:25-22:30 (SGW)

Description: A systematic survey of major invertebrate fossil groups with chief emphasis on morphology, classification and geologic occurrence. Study of principles of evolutionary concepts and zonation. Some selected discussion on paleoecology. Lectures and laboratory.

Texts: Sec. 01
Invertebrate Fossils, Moore, R.C., Lalicker, C.G. and Fischer, A.G. McGraw-Hill

Principles of Paleontology, Raup, D.M., and Stanley, S.M., Freeman

Sec. XX
Invertebrate Fossils, Moore, R.C., Lalicker, C.G. and Fischer, A.G. McGraw-Hill

Handbook of Paleontology for Beginners & Amateurs Part I, The Fossils, Winifred Goldring, Paleontological Research Institute Ithica, N.Y.

Assignments & Grading: Sec. 01
Students must attend at least 70% of lecture and lab sessions. Students must secure a clear passing grade in lab. and theory sections separately.

1st mid term examination	15%
2nd mid term examination	20%
Final examination	25%
Laboratory assignments	40%

Each test will be of 2-3 hours duration. Mid term papers can be reviewed with the instructor. Examination materials include lecture topics, handouts and special reading assignments. Students are also required to attend field trips and write reports.

Sec. XX	
Laboratory exercises	20%
Laboratory exam	30%
Final exam	50%

Prerequisite: Geol. C210 or equivalent



Fossils from the Devonian (NW Argentina)

GEOLOGY C213

STRUCTURAL GEOLOGY (3 credits)

Professor: H.S. de Romer

Sec. 01 TTH 8:45-10:00 (Loy)
 Lab. 01 Mon 14:45-17:30 (Loy)

Sec. XX Mon 18:05-20:10 (SGW)
 Lab. AA Mon 20:25-22:30 (SGW)

Description: Structural Geology is one of the important pillars of the Earth Sciences. The earth is in a state of mobile equilibrium, slowly adjusting to ever-present forces. The movements, whether on surface or within the earth, result in various kinds of deformation. Structural geology is the study and evaluation of structures brought about by deformation. The lectures deal with physical properties of rocks, folds, fractures, primary and minor secondary structures. Particular attention is being paid to minor structures, both primary and those associated with folds, because they are the key to understanding of the pattern of deformation and the sequence of events that shaped the rocks. An important part of the course are the weekly lab periods; orthographic and stereographic methods are used to solve problems encountered in structural work. Knowledge gathered in both lectures and labs is applied during several field trips carried out in various parts of the Appalachian domain. Students are taught to observe, identify and describe geologic structures. Using the multiple working hypothesis, the field trip participants learn to evaluate the structural inventory of the rocks and arrive at the structural evolution of an area.

Texts: Structural Geology, M.P. Billings, 3rd ed. 1972
 Structural Geology, D. Ragan, 2nd ed. 1973
 Graphic Methods in Structural Geology, W. Dunn and J. Shimer 1950

Assignments & Grading:

Laboratory (including tests)	40%
Theory test	10%
Field trips	15%
Final exam	35%

Prerequisite: Geol. C210 or equivalent previously or concurrently, or permission of the department



Chevron folds in the Pyrenees

GEOLOGY C215

PHOTOGEOLOGY (3 credits)

Professor: H.S. de Romer

Sec. 01 MW 13:15-14:30 (Loy)
 Lab. 01 Thu 14:45-17:30 (Loy)

Sec. XX Wed 18:05-20:10 (SGW)
 Lab. AA Wed 20:25-22:30 (SGW)

Description: As in most natural sciences, Photogeology consists of theory and practice. It is part of remote sensing, which can be defined as the detection, recognition, measurement and evaluation of objects that cannot be seen directly, by means of distant recording devices. In this course, conventional black and white aerial photographs are studied with pocket and mirror stereoscopes to interpret the geology of an area. Aerial photographs and images are recognized today as one of the most valuable geologic tools. They reveal information that often cannot be adequately obtained by other methods of investigation. The aerial photo is probably unique in presenting the viewer with an interrelation between landform, erosional processes, rock types, structures, vegetation etc... Using indirect evidence provided by the image and his background knowledge in other fields, the interpreter arrives at the geological evolution of the area viewed. Although lectures and labs are given at separate times, both theory and practicals are generally intergrated. The theoretical part deals with basic geometry and particular properties of aerial photographs and images from both the qualitative and quantitative points of view. In the lab, the student uses geomorphological, lithological and structural evidence to define the geological set up of an area unknown to him before. Using various plotting instruments, groups of students produce geological maps resulting from interpretation of aerial photographs.

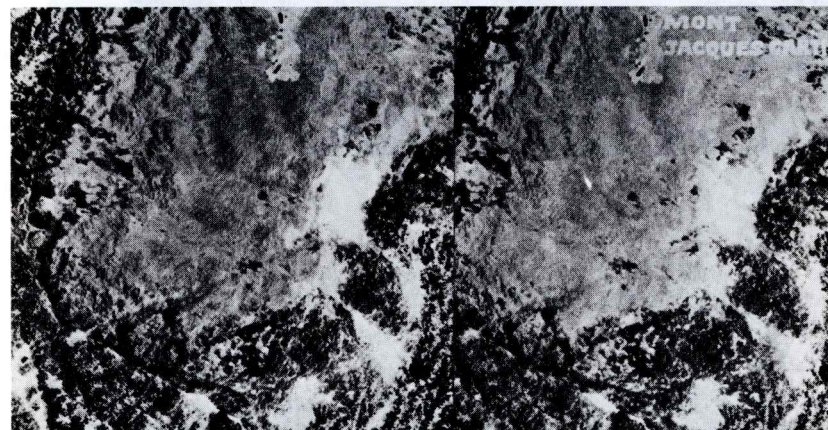
Texts: Aerial Photographs in Geologic Interpretation and Mapping, R.G. Ray, U.S.G.S. Prof. Paper 373, 1960

Aerial Stereo Photograph, H.R. Wanless, Univ. Illinois, 1973.

Assignments & Grading:

Home assignments	25%
Laboratory test	10%
Theory test	10%
Project	20%
Final exam	35%

Prerequisite: Geol. C213 previously or concurrently, or permission of the Department



Stereogram of the Mont J. Cartier area (Gaspé)

GEOLOGY C216

EXPLORATION GEOLOGY (3 credits)

Professor: Staff Sec. A (SGW)

Description: Two-week field school right after final exams. The first part of the course is taken up by surveying and map preparation. The second part includes actual geophysical surveys, using seismic, magnetic, gravity, electrical and radiometric methods. Students will be required to pay for room and board for a one-week period at the Concordia Field School

Prerequisite: Geol. C221



You must stay afloat in exploration!

17.

GEOLOGY C220

EARTH HISTORY (3 credits)

Professor: T.B.A. Sec. 51 Mon 19:00-21:00 (Loy)
Sec. AA Thu 18:05-20:10 (SGW)

Description: The study of the Earth can be divided into two interrelated parts. namely: Physical Geology, and Earth History or Historical Geology. While the former deals mainly with descriptive and static aspects of Geology, Historical Geology looks at the Earth from a dynamic and global, evolutionary point of view, stressing Time and Life as its most important elements. It is while studying the historical aspects of geology that one becomes aware that these 2 dimensions have been added. The course stresses two aspects of Earth History, namely, a) the principles, i.e. that earth materials are the natural products of physical, chemical and biological processes in Time. It is important to realize here, that the greater part of the record is tied up with sedimentary rocks; and b) the Earth History proper, i.e. the evolution of the earth as a globe throughout the eras. Since the physical and biological aspects of the earth's evolution cannot effectively be separated, the development of life forms through time is also explored

Texts: Historical Geology, L.W. Mintz, 3rd ed., Charles E. Merrill
The Earth Through Time, H.L. Levin

Assignments & Grading: 1st test 10%
2nd test 10%
Review questions I 10%
Review questions II 10%
Final Exam 60%

Prerequisite: No previous background in geology required.



Configuration of oceanic bottom in the NW Atlantic

18.

PHYSICS OF THE EARTH (3 credits)

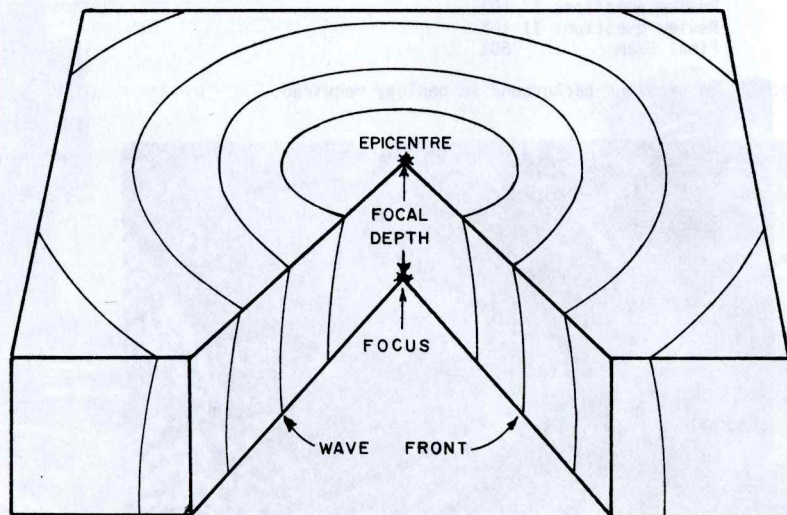
Professor: S. Kumarapeli	Sec. 01	TTh	11:45-13:00 (Loy)
	Lab. 01	Tue	14:45-17:30 (Loy)
	Sec. X	WF	13:15-14:30 (SGW)
	Lab. A	Fri	14:45-17:30 (SGW)

Description: This course is directed toward the general understanding of physical phenomena of the solid earth. Subjects for consideration include the following: earth's origin, age, radioactivity, magnetism, gravity field, seismology, heat flow, structure and physical state of the earth's interior, theory of sea-floor spreading, theories of mountain formation. Lectures and laboratory.

Texts: Earth like Planets, B. Murray, M. Malin & R. Gresly, Freeman
Geophysical Methods in Geology, P.V. Sharma, Elsevier

Assignments & Grading: Laboratory assignments 25%
Term paper 15%
Examinations 60%

Prerequisite: CEGEP Math. 103,203, Geol. C210 or equivalent



Concepts of earthquake epicentre, focal depth and focus

INTRODUCTORY PETROLOGY (6 credits)

Professor: T.B.A.	Sec. 01	TTh	11:45-13:00 (Loy)
	Lab. 01	Fri	14:45-17:30 (Loy)
	Sec. XX	Thu	18:05-20:10 (SGW)
	Lab. AA	Thu	20:25-22:30 (SGW)

Description: The identification and description of hand specimens of igneous, sedimentary and metamorphic rocks. Rock associations. Classification and origin of major rock groups. Lectures and laboratory.

Texts: None. This course draws on many sources for its materials, and there are many recommended references, some of which serve as texts in other courses.

- Winkler, H.G.F. Petrogenesis of the Metamorphic Rocks, 5th ed., Springer Verlag, 1979
- Spry, A. Metamorphic Textures, Pergamon 1969
- Travis Russell. Classification of Rocks, Colorado School of Mines quarterly, vol. 50, 1955.
- Ehlers, E.G. and H. Blatt. Petrology, W.H. Freeman & Co., 1982
- Greensmith, J.T. Petrology of the Sedimentary Rocks, 6th ed. George Allen and Unwin, 1978.

Assignments & Grading: Weekly reports in labs 25%
Three sectional lab exams 25%
Final exam 50%

Prerequisite: Geol. C211



Megacrystic and xenolithic basic igneous dyke rock

MINERALOGY II (3 credits)

Professor: J.T. Jenkins

Sec. 01 TTH 10:15-11:30 (Loy)
 Lab. 01 Tue 14:45-17:30 (Loy)

Description: Point and translational symmetry, point groups, space groups, interpretation of space group tables, elements of crystal chemistry, chemistry and phase relations of important rock forming minerals. Stereographic projections of crystal data; the Universal Stage and powder diffractometry in identifying minerals and subjects stressed in laboratories. Lectures and laboratory.

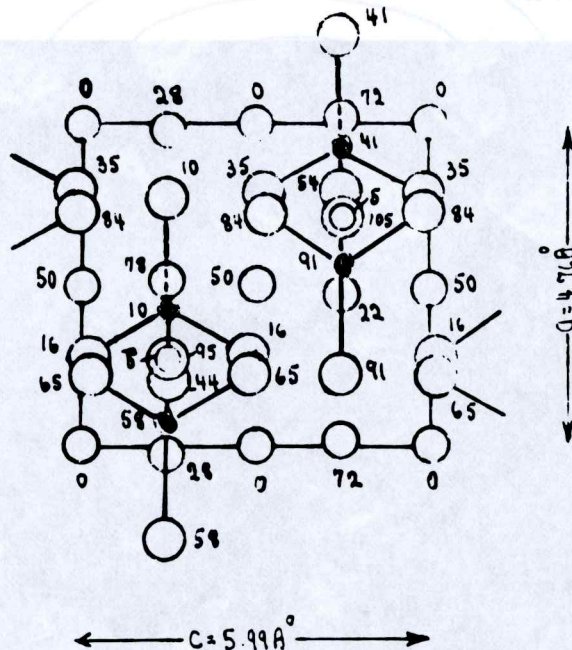
Texts: Bloss, F.D. Crystallography and Crystal Chemistry, Holt, Rinehart and Winston, 1971.

Recommended References:

- Hutchison, C.S. Laboratory Handbook of Petrographic Technique, John Wiley & Sons, 1974.
- Deer, Howie and Zussman. Introduction to the Rock Forming Minerals (paper), Longmans, 1966.
- Phillips, W.R. and D.T. Griffen. Optical Mineralogy; the non-opaque minerals, Freeman & Co., 1981.

Assignments & Grading: Laboratory assignment 35-45%
 Final exam 65-55%

Prerequisite: Geol. C211 and very strongly recommended C313



Crystal structure of the olivine, fosterite, projected on the (010) plane. Origin at upper right corner.

GEOLOGY C313

OPTICAL CRYSTALLOGRAPHY (3 credits)

Professor: J.T. Jenkins

Sec. 01 WF 10:15-11:30 (Loy)
 Lab. 01 Thu 14:45-17:30 (Loy)

Description: Behaviour of light in crystals. The optical indicatrix. The polarizing microscope and optical properties of minerals. Identification of non-opaque minerals in oil immersion and thin sections. If time permits use of the Universal Stage will be introduced. Lectures and laboratory.

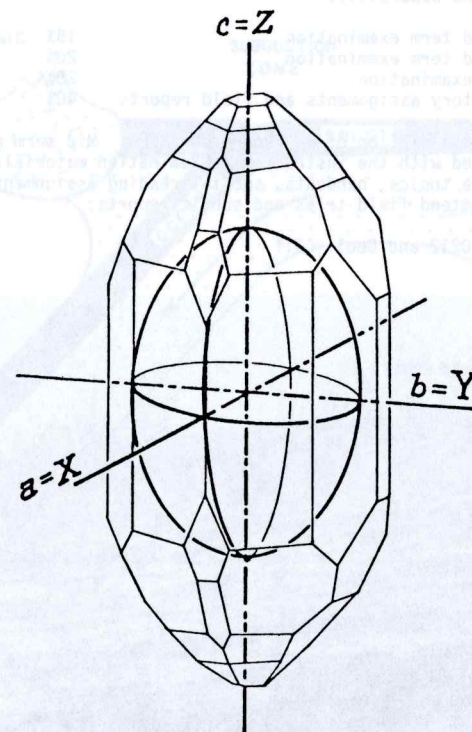
Texts: a) either: F.D. Bloss. An Introduction to the Methods of Optical Crystallography. Holt, Rinehart, Winston, 2nd ed. 1974.

or: E.E. Wahlstrom. Optical Crystallography, 5th ed., John Wiley & Sons, 1976.

b) Phillips, W.R. and D.T. Griffen. Optical Mineralogy; The Non-opaque Minerals. Freeman & Co., 1981.

Assignments & Grading: Weekly laboratory assignments 25%
 Laboratory exam 25%
 Final exam 50%

Prerequisite: Geol. C211



Optical orientation of orthorhombic crystal

STRATIGRAPHY (3 credits)

Professor: K.K. Mukherji

Sec. 01 TTH 8:45-10:00 (Loy)
 Lab. 01 Tue 14:45-17:30 (Loy)

Description: Introduction to historical developments of stratigraphic concepts. Role of natural dynamic processes in the evolution of stratigraphic record. Discussion on stratigraphic classification and nomenclature. Major classification of tectonic elements in sedimentary basins and broad patterns in the distribution of sedimentary rocks in relation to tectonic framework. Detailed analysis of stratigraphic principles such as correlation (lithostratigraphic, biostratigraphic, chronostratigraphic) facies (lithofacies; biofacies), unconformities and cyclotherm. Critical evaluation of stratigraphic sequences using modern and ancient examples for the recognition of aeolian, alluvial fan, fluvial, lacustrine, tidal flats, barrier coastlines, carbonate shoreline, shallow marine and submarine environments. Lectures and laboratory.

Texts: Matthews, R.K. Dynamic Stratigraphy. Prentice Hall.
 Reading. H.D. Sedimentary Environments and Facies. Elsevier
 Dunbar, C.O. and Rodgers, J. Principles of Stratigraphy. John Wiley.

Assignments & Grading: Students must attend at least 70% of lecture and lab sessions. Students must obtain a clear passing grade in theory and lab sections separately.

1st mid term examination	15%
2nd mid term examination	20%
Final examination	25%
Laboratory assignments and field reports	40%

Each test will be of 2-3 hours duration. Mid term papers can be reviewed with the instructor. Examination materials include lecture topics, handouts, special reading assignments. Students must attend field trips and submit reports.

Prerequisite: Geol. C212 and Geol. C311



Pennsylvanian cyclothem (west Virginia)

TECTONICS (3 credits)

Professor: S. Kumarapeli

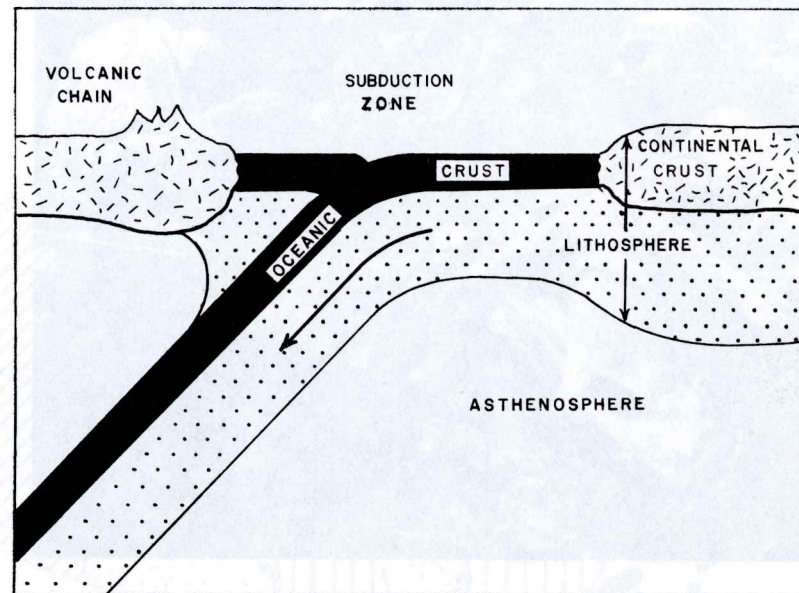
Sec. 01 WF 10:15-11:30 (Loy)
 Lab. 01 Mon 14:45-17:30 (Loy)

Description: Variations of physical properties in the Earth. Detailed structure of the Upper Mantle. The Crust: crystal types; tectonics of shields, platforms and Phanerozoic fold belts; continental rifts; island arcs; trench belts; oceanic rises. Critical evaluation of the hypothesis of sea floor spreading. Plate tectonics critical evaluation of the hypothesis; magma associations; plate reconstructions. Crustal origin and growth. Laboratory work: studies of tectonic maps of crustal types from continents. Lectures and laboratory.

Texts: Introduction to the Structure of the Earth, E.W. Spencer, McGraw Hill

Assignments & Grading: Laboratory assignments 30%
 Examinations 70%

Prerequisite: Geol. C213, C221



A lithospheric plate descending into the mantle under the leading edge of another plate

FIELD GEOLOGY (3 credits)

Professor: Staff

Sec. 01 (Loy)

Description: Two-week field work right after the final examination period. Working in groups of two, students will map an area, prepare sections and write a geological report. Group studies of important outcrops or outcrop areas and quarries. Students are expected to pay for room and board. Field Work: 2 weeks in May at the Concordia Field School.

Prerequisite: Geol. C213 and C311



Do you see what I see?

GEOLOGY OF CANADA (3 credits)

Professor: T.B.A.

Sec. XX Tue 18:05-20:10 (SGW)
Lab. AA Tue 20:25-22:30 (SGW)

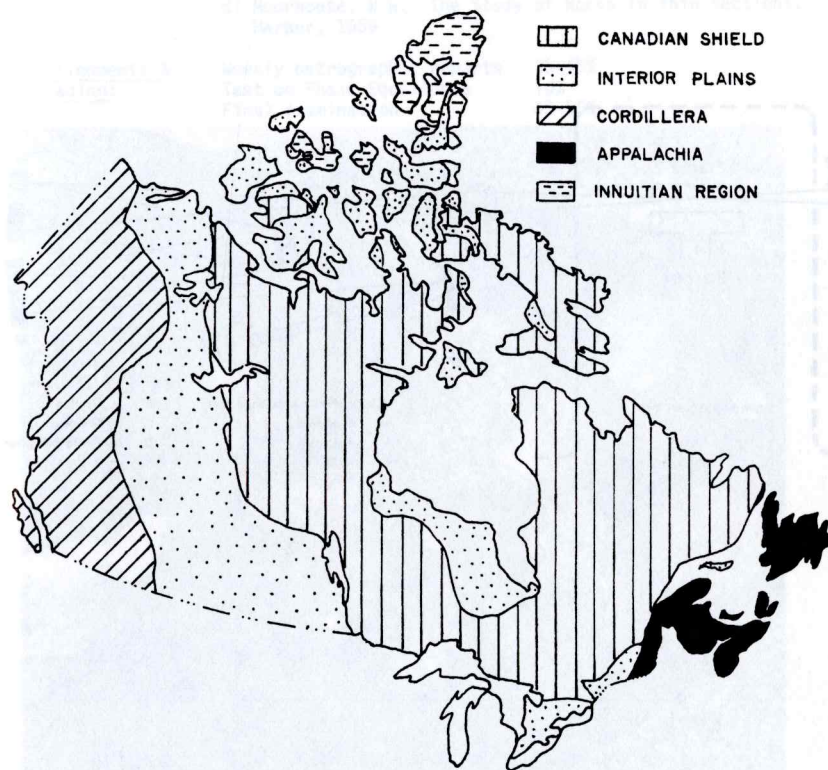
Description: Geologic study of the major geomorphic subdivision of Canada with special emphasis on stratigraphy, correlation, paleogeography, sedimentation and tectonics. Reading assignments and colloquium are used to probe into specific problems. Lectures and seminar.

Texts: Geological Evolution of North America, G.W. Stearn, R.L. Carroll and T.H. Clark, John Wiley

Assignments & Grading:	Seminars	40%
	Mid term examination	20%
	Final examination	40%

During this course each student is required to give at least four talks based on assigned readings. Final examination is based on entire course material. To obtain a pass in this course it is essential to obtain a pass mark in the final examination as well as aggregate pass mark.

Prerequisite: Geol. C201 and C210 (Geol. C314 or C212 also is recommended)



Geological subdivisions of Canada

GEOLOGY C324

ANALYTICAL METHODS IN GEOCHEMISTRY (6 credits)

Professor: T.B.A.

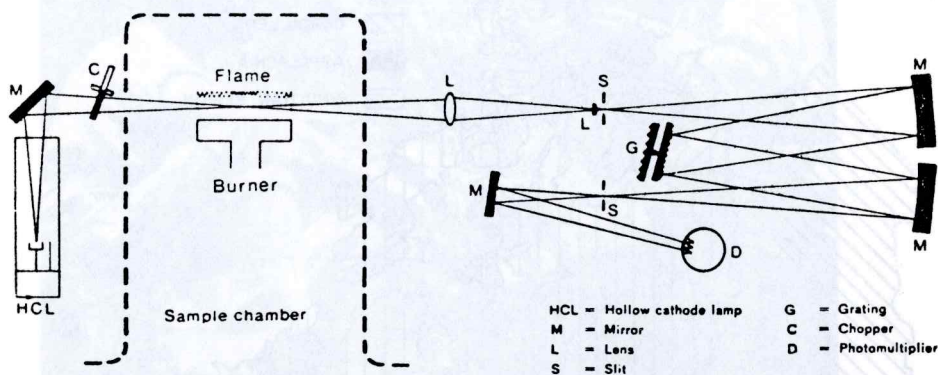
Sec. X TTH 8:45-10:00 (SGW)
 Lab. A Wed 14:00-18:00 (SGW)

Description:

Chemical equilibrium as applied to volumetric and gravimetric procedures; general theory of volumetric titrations, titration curves; application of general titration theory of neutralization precipitation; complexation oxidation-reduction and nonaqueous solvent titrations; theory of potentiometry and potentiometric titrations; theory of gravimetric analysis; methods of separation by chemical and physical means, electro-gravimetry and electrolytic separations; absorptimetric theory and absorptimetric methods of analysis. Analyses of major and minor components of geological material. Lectures and laboratory.

Prerequisite:

CEGEP Chem. 201, CEGEP Phys. C301, CEGEP Math. 103 and 203, or equivalent courses.



Optics of an atomic absorption spectrometer

GEOLOGY C411

IGNEOUS AND METAMORPHIC PETROLOGY (6 credits)

Professor: J.T. Jenkins

Sec. 01 MW 13:15-14:30 (Loy)
 Lab. 01 Mon 14:45-17:30 (Loy)

Description:

Interpretation of phase diagrams. Mineralogy, fabric and petrogenesis of igneous and metamorphic rocks. Magmatic and metamorphic processes. ACF and AKF diagrams for various metamorphic facies. Study of selected problems. Lectures and laboratory.

Texts:

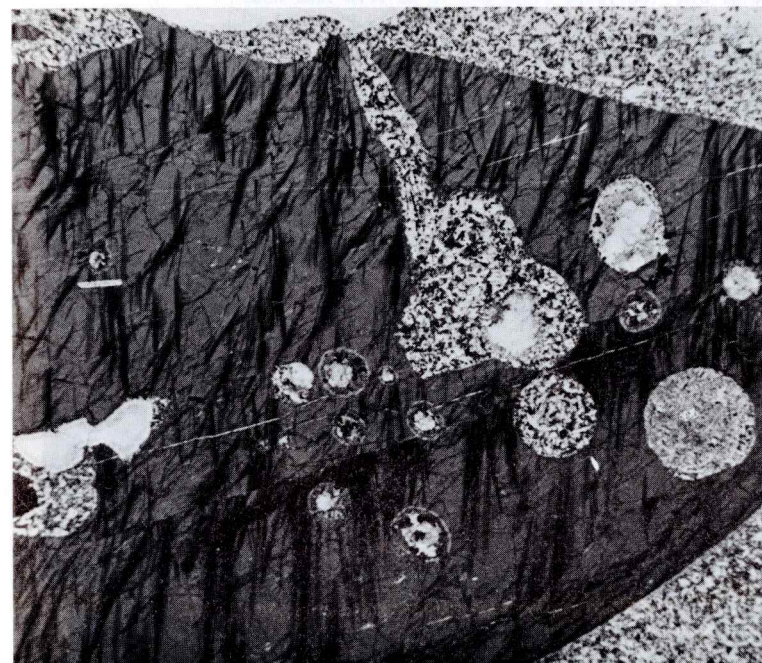
- Phillips, W.R. and D.T. Griffin. Optical Mineralogy, the Non-opaque minerals. Freeman & Co., 1981.
- Winkler, H.G.F. Petrogenesis of the Metamorphic Rocks, 5th ed., Springer-Verlag, 1979

Recommended References:

- Ehler's, E.G. The interpretation of Geological Phase Diagrams. Freeman & Co., 1972.
- Deer, Howie and Zussman. An Introduction to the Rock Forming Minerals (paper). Longman's 1966.
- Spry, A. Metamorphic Textures. Pergamon, 1969
- Moorhouse, W.W. The Study of Rocks in Thin Sections. Harper, 1959.

Assignments & Grading:

Weekly petrographic reports	35-45%
Test on Phase Equilibria	10%
Final examination	45-55%



Thin section; amphibole megacryst embedded in, and enclosing spherical patches of, camptonitic matrix.

ECONOMIC GEOLOGY AND ORE DEPOSITS (6 credits)

Professor: G.P. Sassano

Sec. 01 TTH 11:45-13:00 (Loy)
 Lab. 01 Fri 14:45-17:30 (Loy)

Description: The economics of the mining industry, resource to reserve, grade and tonnage estimation, economic valuation of mineral deposits. Ore forming processes, structural and physico-chemical controls of ore forming processes, geothermometry and isotopic studies, general classification of ore deposits, geology of representative world-class mining districts. Laboratory includes ore reserve calculations, property evaluation, ore microscopy, term projects and seminars. Lectures and laboratory.

Texts Stanton. Ore Petrology. McGraw-Hill

Recommended: Park and McDiarmid. Ore Deposits. Freeman

Barnes. Geochemistry of Hydrothermal Ore Deposits. Wiley Interscience

Craig and Vaughan. Ore Microscopy and Ore petrology. Wiley Interscience

Assignments & Grading:

Term tests	15%
Laboratory reports, seminars	30%
Laboratory final examination	15%
Final written examination	40%

Prerequisite: Geol. C213 and C311.



It is nice to have lasagna in the bush!

SEDIMENTARY PETROLOGY (3 credits)

Professor: K.K. Mukherji

Sec. 01 TTH 10:15-11:30 (Loy)
 Lab. 01 Tue 14:45-17:30 (Loy)

Description: General principles of sediment diagenesis, followed by detail analysis of the diagenetic evolution of sandstone, shale and carbonate rocks. Emphasis is placed heavily on the microscopic criteria in the recognition of diagenetic fabric. Problems of primary sedimentary structures and their hydro dynamic interpretation are also discussed. Specialized topics on current development in sedimentary lithogenesis are also included.

Texts: Blatt, H. Middleton, C., and Murray, R. Origin of Sedimentary Rocks. Prentice Hall.

Bathurst, R.G.C. Carbonate Sediments and their Diagenesis. Elsevier

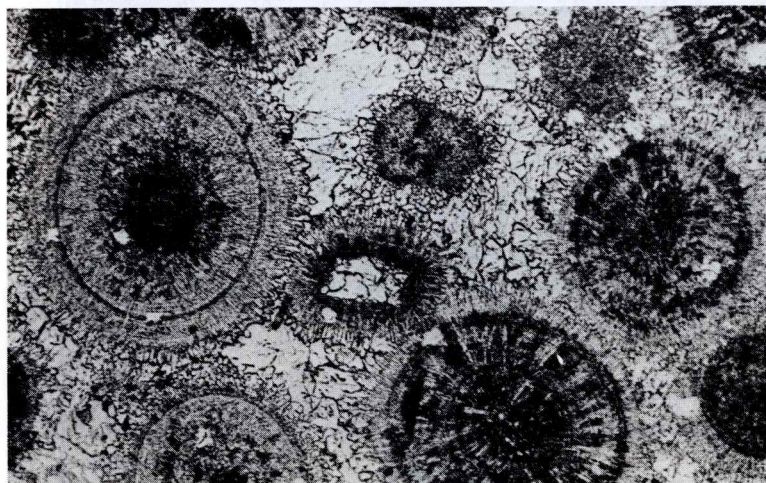
Larsen, G., Chilingar, G.V. Diagenesis in Sediments. Elsevier

Assignments & Grading: Students must attend at least 70% of lecture and lab sessions. Students must secure a clear passing grade in theory and lab portions separately.

1st mid term examination	15%
2nd mid term examination	15%
Laboratory assignments	50%
Final examination	20%

Each test will be of 2-3 hours duration. Mid term papers can be reviewed with the instructor. Examination materials include lecture topics, handouts, special reading assignments.

Prerequisite: Geol. C311 and Geol. C313



Mid. Ord. oösparite with early and late diagenetic cement fabric (S. Ont.)

RESEARCH PROJECT (6 credits)

Professor: Staff

Sec. 01 (Loy)

Description:

Honours students in their final year are expected to show competence in isolating and examining a geological problem using techniques available within the department, working in conjunction with assigned faculty advisers. Student evaluation will be based on the student's performance in the investigation and on the written report. Specialized students may also take the course at the discretion of the Department. 6 hours per week.

Prerequisite:

Permission of the Department



Volcanic and sedimentary strata in a semi-arid environment (Chile)

EXPLORATION GEOCHEMISTRY (3 credits)

Professor: T.B.A.

Sec. XX 18:05-20:10 (SGW)
Lab. AA 18:30-22:30 (SGW)

Description:

Basic principles; primary and secondary dispersion processes and their significance in geochemical exploration; field and analytical techniques (one field excursion early in the fall term); interpretation of geochemical data; organization of exploration programmes; selected case histories. Lectures and laboratory.

Texts:

Introduction to Exploration Geochemistry, A.A. Levinson.
Applied Publishing

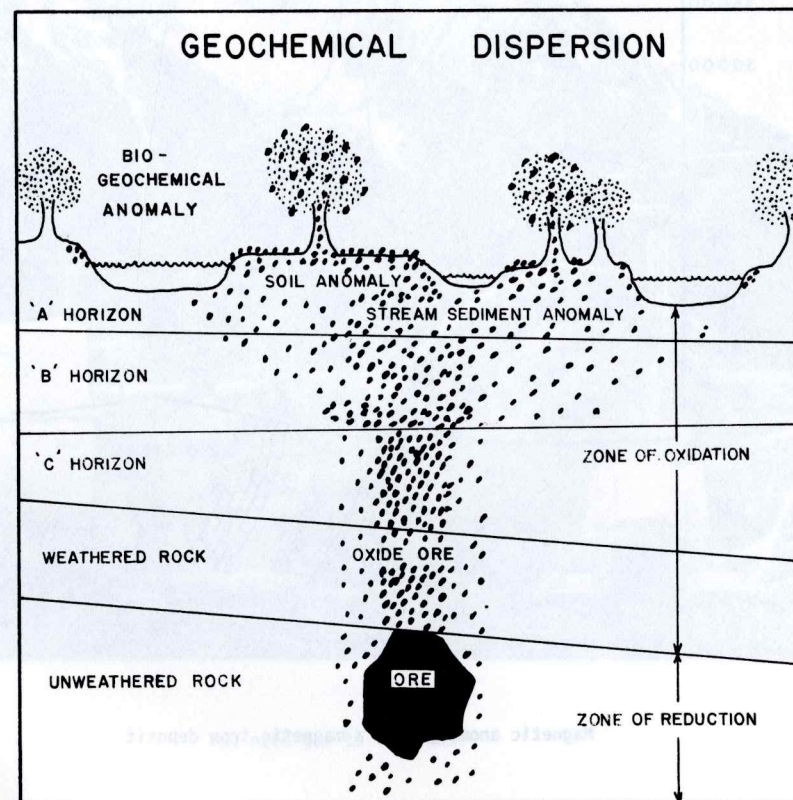
Assignments
& Grading:

Laboratory work & field trip report	35%
Term paper	15%
Mid term	15%
Final examination	35%

Final examination is based on entire course material. To obtain a pass in this course it is essential to obtain a pass mark in the final exam as well as aggregate pass mark.

Prerequisite:

Geo1. C210, C211 or permission of the Department



Basic conditions allowing geochemical exploration for ore deposits

EXPLORATION GEOPHYSICS (3 credits)

Professor: S. Kumarapeli

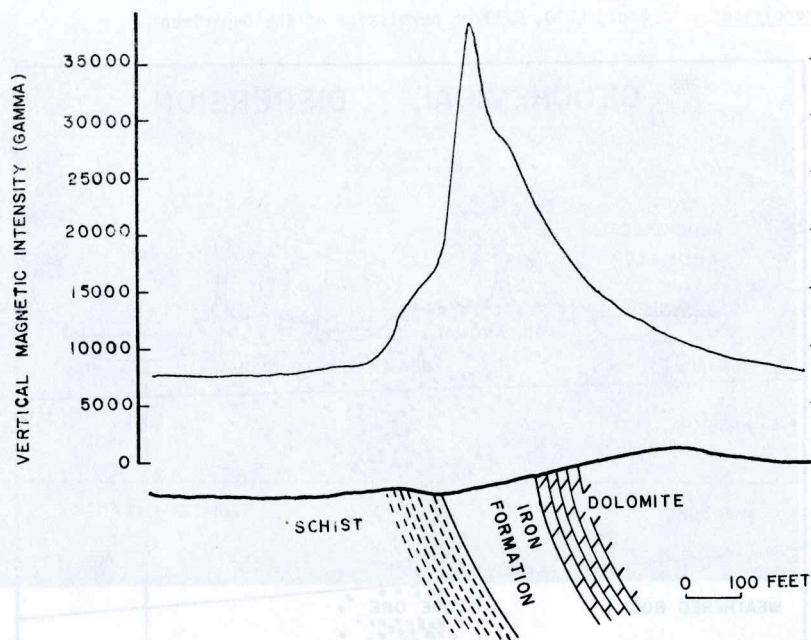
Sec. 01 TTH 8:45-10:00 (Loy)
 Lab. 01 Thu 14:45-17:30 (Loy)

Description: A brief study of the principles of magnetic, gravimetric, electric and seismic methods of mineral exploration; interpretation of geophysical data; organization of exploration programmes; selected case histories. Lectures and laboratory.

Texts: Applied Geophysics, Telford, W.M. Cambridge

Assignments & Grading: Laboratory assignments 25%
 Seminars 15%
 Final examination 60%

Prerequisite: Geol. C210, C211 or permission of the Department



Magnetic anomaly over a magnetic iron deposit

FOSSIL FUELS (3 credits)

Professor: K.K. Mukherji

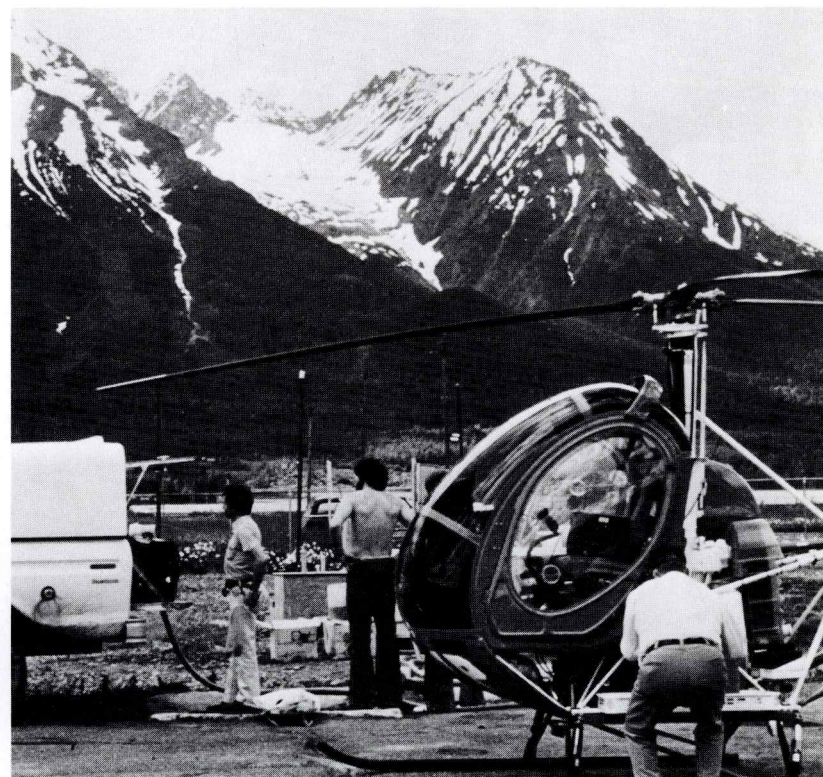
Sec. 01 WF 8:45-10:00 (Loy)

Description: Origin and accumulation of petroleum hydrocarbons and coal. Distribution of oil, natural gas and coal deposits as a function of geological environments. Geology of major oil and coal fields of the world. Global energy requirements and production forecasts. Lectures only.

Texts: None

Assignments & Grading: Mid term 40%
 Final examination 60%

Prerequisite: Geol. C314, C315 or permission of the Department



You need gas to find gas!